

Duodenal Ulcer

Rationale and Results of Antrectomy and Subtotal Vagotomy

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ALTHOUGH THE BASIC CAUSE of duodenal ulcer remains unknown, the importance of gastric acidity is a generally accepted premise motivating the surgical treatment of this lesion. Whereas adequate reduction of acids seems essential, complete achlorhydria seems neither necessary nor desirable. Since the vagus nerves are known to be of physiologic importance, they should not be destroyed unless necessary. Despite the apparently conflicting results of animal experiments the physiologic importance of the antrum also seems to be established now. Therefore the antrum likewise should not be destroyed unless necessary. Unfortunately, in the light of available data, it appears that it is necessary to remove most of both of these elements in order to obtain the best collective clinical results in the surgical treatment of duodenal ulcer.

There is experimental evidence in dogs that the stomach possesses an adequate intragastric acid regulating mechanism not necessarily dependent upon duodenal regurgitation. The neutralizing capacity of the duodenum of dog in vivo is in excess of physiologic needs.^{5, 6, 7}

What, then, breaks this regulating mechanism in certain persons, permitting the occurrence of duodenal ulcers? Possibly one reason this question remains unanswered is that animals available for study do not possess the clinical ulcer diathesis of humans. How then can one know that the results are comparable? Furthermore, marginal ulcers rarely occur in humans who have not had duodenal ulcer.⁸

About ten years ago one of the authors (Stevens) became somewhat doubtful about resection of two-thirds or more of the stomach for duodenal ulcer. Concern over the incidence of weight loss, anemia and the mutilating nature of this procedure for a benign lesion was inescapable. A further consideration was that results of fundusctomy in dogs were disappointing from a long range standpoint. Fur-

• Results in a series of 107 cases indicated that antrectomy (hemigastrectomy) combined with subtotal vagotomy of both vagus nerves for duodenal ulcer is followed by better overall results than the more radical subtotal gastrectomy or vagotomy plus drainage procedures.

Antrectomy combined with total vagotomy is followed by a slightly smaller incidence of marginal ulcer but is accompanied by more motility disturbances.

thermore, the incidence of marginal ulcers persisting after multiple high resections was discouraging.

Clinical study of hemigastrectomy alone including the antrum was discontinued after the occurrence of a marginal ulcer within six months after operation in one of the first eight patients so treated. Experience with vagotomy procedures was likewise somewhat discouraging, owing to disturbances of motility and the occurrence of marginal ulcers two years after operation in three of the first 43 patients subjected to the operation.^{3, 9} Two of these patients had negative insulin tests. Hence interest turned to the possible effects of a less mutilating combined surgical attack on both the nervous and hormonal elements involved in the secretion of gastric acid by some form of antrectomy and vagotomy which might be effective yet lessen the incidence of untoward side effects. It was decided to study a relatively small control series of cases carefully. The procedure adopted was conservative hemigastrectomy including most of the antral element with subtotal vagotomy of both vagus nerves. Division of only one vagus nerve already had been observed to be of no value. The subtotal rather than total vagotomy idea evolved from the concept that motility disturbances might be eliminated.

There was, understandably, some early condemnation of this procedure on the basis that it constituted inadequate gastric resection and inadequate vagotomy. Opposed to this attitude, however, was the observation that the secretin-like acid-stimulating factor seems to be largely in the gastric antrum and that without the antrum the fundic secretion of acid is reduced. To quote Walters¹⁵: "In my experience from 72 per cent to 75 per cent of such cases have obtained a relative achlorhydria follow-

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ing Billroth II or Polya types of operation for duodenal ulcer. This is in contrast to 12 per cent who obtain it following a gastroenterostomy and 34 per cent to 36 per cent when a vagotomy and gastroenterostomy are done simultaneously." It is pertinent that stomal ulcers that developed after exclusion operations have been cured by secondary operation to remove the remaining antrum.

Woodward and Stevens recently began an experimental study in dogs to ascertain the comparative effect of antrectomy and gastroenterostomy alone in the reduction of gastric acids. The approach is more physiologic than those heretofore undertaken. Results will be published when the study is completed.

The recent antral pressure theory seems untenable clinically in some cases for two reasons. One is that it is difficult to conceive a consistently significant antral pressure, even with the antral pouch closed by suture and with spasmodic pyloric contraction, except in cases of obstructing duodenal ulcer preventing adequate drainage through the duodenum. Secondly, stomal and recurrent duodenal ulcers following so-called complete vagotomy with negative insulin tests and well placed adequate gastroenterostomy or pyloroplasty have been cured by subsequent gastrectomy including the antrum.^{10, 11} No more than normal physiologic pressure obtains in those cases.

It seems inconceivable either that the antral pressure factor can be eliminated in all cases or that the acid inhibiting factor (which operates in the relatively empty stomach) can be sufficiently activated with the stomach full of food, regardless of what kind of gastroenteric opening is made to enhance the emptying of the stomach. Results supporting these concepts were noted in studies of animals without ulcers in which there is a known adequate acid-regulating mechanism. In patients with ulcers, this mechanism apparently is impaired.

The value of subtotal section of both vagus nerves appears more subject to question. However, a fair estimate is that vagotomy is complete in only 60 per cent to 80 per cent of cases.² Gastroenterostomy alone prevents marginal ulcers in half of the incomplete vagotomies, and since stomal or recurrent duodenal ulcers do not develop at all in the other half, how can one arbitrarily assume that incomplete vagotomy is of no value?

Probably the term *adequate vagotomy* were better than *total vagotomy*, since vagus fibers traverse the esophageal musculature in an appreciable number of cases. The only way to make sure of total vagotomy in all cases would be transection of the esophagus—too hazardous a procedure for use in dealing with a benign lesion.

Recent reports of competent clinical surgeons suggest that antrectomy and vagotomy for duodenal

ulcer is the procedure of choice. The results reported parallel the longer experience of the authors.

METHOD

The method of operation used is comparatively simple. The photographs^{2, 15} of anatomic dissections of Dragstedt and Woodward,² Walters¹⁵ and others clearly show that most of the fibers of both vagus nerves accumulate between the lesser curvature of the stomach and the coronary artery. On this basis, subtotal section of both vagus nerves was effected in the earlier cases in the series by dissection, cleaning off the lesser curvature of the stomach to a point just below the gastroesophageal junction and making a high mass ligation of the vagus nerve fibers including the coronary artery (Figure 1, *left*). In more recent cases, more complete vagotomy was done (Figure 1, *right*).

The antral element in humans, unlike that in dogs, appears to shade out up to at least the middle portion of the lesser curvature of the stomach. Therefore, in order to eliminate this element as much as possible, the stomach was divided at the midportion of the lesser curvature, great care being taken in selecting the midpoint. Since the portion of the stomach above this portion is wider than the portion below it, hemigastrectomy as carried out in this series involved the removal of between 40 and 50 per cent of the stomach.

After it was noted that removing the duodenal ulcer was not necessary if there was no pyloric antrum left intact, excision of the ulcer was dispensed with. The duodenal stump was closed simply by a continuous through-and-through chromic 000 catgut suture and a second inverting continuous layer of chromic 000 catgut including the anterior surface of the duodenum and the capsule of the pancreas. The angles were reinforced by interrupted silk or cotton sutures.

Gastrojejunal anastomosis was effected simply by two continuous layers of chromic 000 catgut sutures, one merely a running-over suture and the other a continuous inverting seromuscular suture. Since the only tension on the suture line was at the angles, reinforcement with interrupted cotton or silk sutures was done there only. Anastomosis of an anterior Polya type was used—a long proximal jejunal loop attached to the lesser curvature with the distal loop emerging from the greater curvature. A modified Hofmeister or a tuck procedure devised by the authors was carried out at the distal end of the lesser curvature.

When the anastomosis is completed it is important that the stomach be placed in the left side of the abdomen to prevent the site of the gastrojejunal anastomosis from adhering to the more narrow

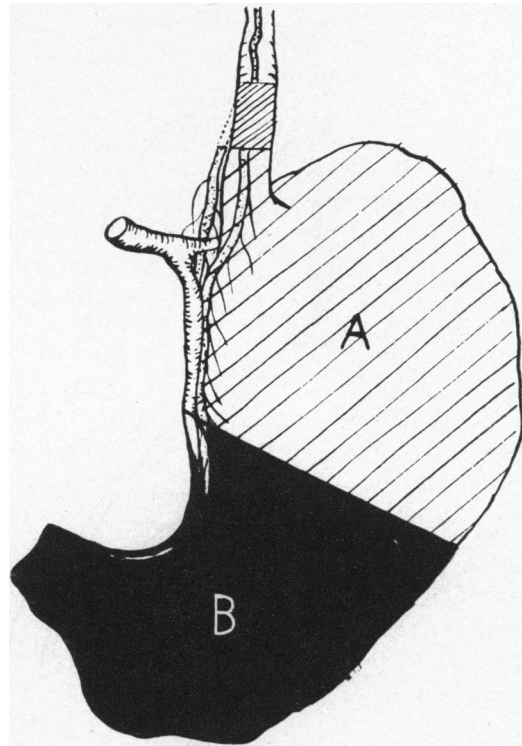
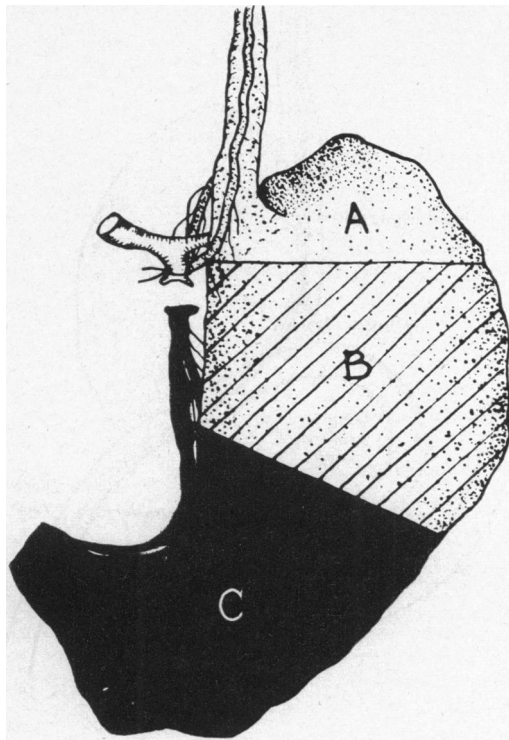


Figure 1—*Left*: Division of the accumulation of the fibers of both vagus nerves between the lesser curvature of the stomach and the left gastric artery is shown. *A*—Vagus nerve fibers intact. *B*—Denervated portion of remaining stomach after hemigastrectomy. *C*—Portion of stomach removed. Subtotal vagotomy of this type results in no motility disturbances. *Right*—So-called total vagotomy. *A*—Denervated portion of remaining stomach. *B*—Portion of stomach removed. In vagotomy of this type, motility disturbances occur in some cases.

space between the vertebral column and the anterior abdominal wall in the midline.

The method of wound closure consisted of continuous chromic 0 and chromic 00 layer closure and continuous everting wound closure supplemented by through-and-through heavy silk retention sutures placed not more than an inch away from the midline and not more than an inch apart.⁴

This procedure from skin incision to skin closure, can be carried out without haste in not more than an hour and a half and sometimes in less than an hour.

The procedure was arrived at through trial and error. Originally the anterior Polya anastomosis was constructed with a short proximal jejunal loop attached directly to the lesser curvature. There were incidences of proximal loop dilation, apparently from the current of food entering the proximal loop from the pathway along the lesser curvature of the stomach (magenstrasse). This seemed to be the cause of certain instances of dumping-like syndromes. There were also instances of proximal loop obstruction in these cases.

In an attempt to correct these complications, the procedure was reversed: The proximal loop was placed at the greater curvature and the distal loop

at the lesser curvature. This procedure was discontinued because there was difficulty in emptying of the stomach in certain cases. The greater curvature of the stomach stretched more than the lesser curvature, and pockets developed at the lower elongated curvature angle, where accumulations of barium were observed roentgenographically.

The procedure was then again reversed, placing the proximal loop at the lesser curvature. This time, however, a long proximal loop was used to prevent proximal loop obstruction (Figure 2). There is no contraindication to this, as absorption of alkaline juices in such a loop is negligible. How long to make the loop cannot be said exactly. It suffices to select a portion of jejunum of adequate length where the mesentery is long enough to leave enough space for the transverse colon and mesocolon to pass behind it without undue pressure. (In the present series, if the omentum was unduly large it was partially resected.) Care must be taken, however, not to make the proximal loop so long that it could slip behind the distal jejunal loop and thus become obstructed. With a loop of proper length this complication can be prevented by two precautionary measures. The site of anastomosis should be, as nearly as practicable, at the first long seg-

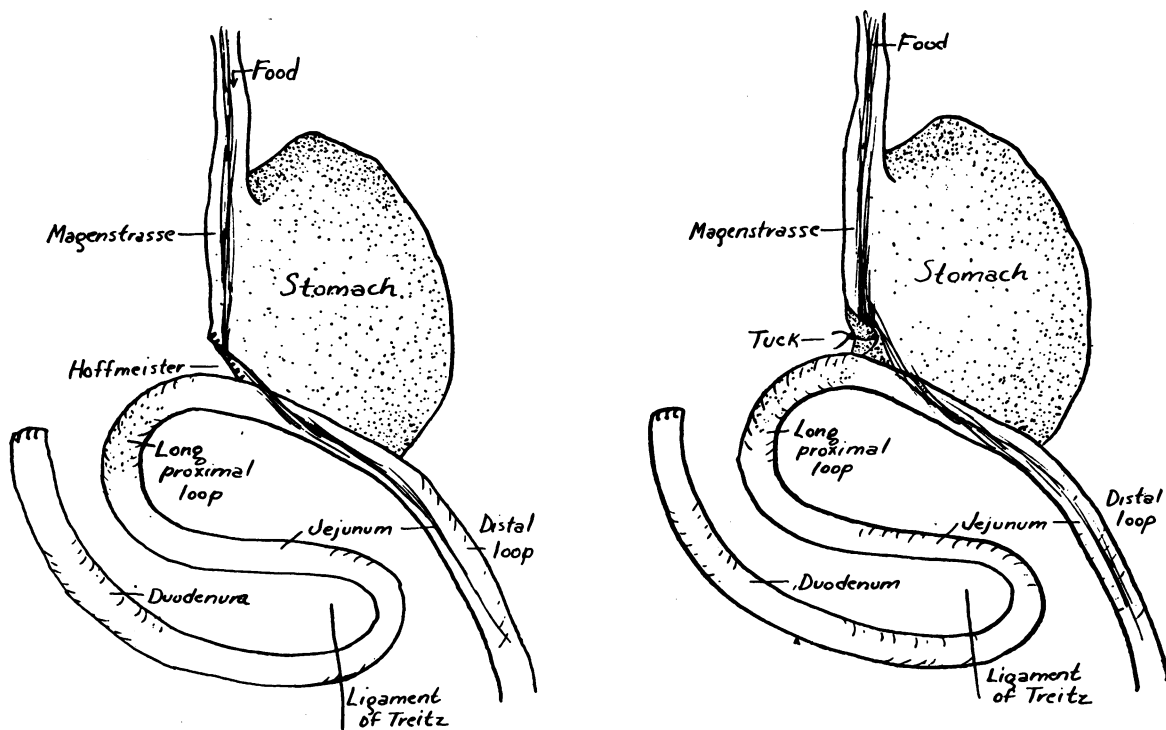


Figure 2.—Satisfactory modifications of anterior Polya procedure, which prevent proximal loop distention. The long loop precludes proximal loop obstruction.

ment of mesentery. A long segment of mesentery between the ligament of Treitz and the lesser curvature of the stomach results in a redundant proximal loop which can possibly fall to the left behind the distal loop. Placing the anastomosed stomach to the left side of the abdomen is also helpful, for then the point of emergence of the proximal jejunum from the ligament of Treitz and the point of jejunal attachment at the gastric lesser curvature are more or less in line on the left side of the abdomen. Thus the distance between these two points is shortened and the proximal jejunal loop need not be so long.

In order to divert the flow of gastric contents from the proximal loop, either a Hofmeister or a tuck procedure was carried out on the lesser curvature of the stomach (Figure 2).

Early in the series, posterior Polya procedures were used. Subsequently either posterior or anterior anastomosis was done, the choice depending upon conditions in each case. Finally the anterior procedure was done routinely. It saves time and so far as could be observed there are no contraindications.

RESULTS

One general observation with regard to results was that in the first six months after operation there was a good deal of variation between cases, but after six months the results were consistent. Pos-

sibly a factor is a compensatory enlargement of the stomach in that period. It is important that in future comparisons this time factor be kept in mind.

In a preliminary report in 1948 of a relatively small series of hemigastrectomy of the Polya type with subtotal vagotomy of both vagus nerves, and in subsequent reports, one of the authors expressed the belief that the more radical so-called adequate gastric resection should not be discarded generally.^{12, 13} In the light of subsequent experience he changed his mind.¹⁴

The present series is made up of 107 cases and the average time of observation since operation is six years. The operations were done at St. John's Hospital and at Wadsworth Hospital.

Only one patient in the series had a marginal ulcer and there was no recurrence following a more complete vagotomy six years ago. The patient has had motility disturbances, however. On this basis it would appear that, had complete vagotomy been done in all cases, there would have been no incidence of marginal ulcer in this series. How this would have affected the good results so far as motility is concerned is problematical.

Postoperative data included roentgen studies with barium. In no instance was gastric retention, proximal loop obstruction or dilatation or other motility disturbances demonstrated.

In one case symptoms of a dumping-like syndrome were present. In two other cases this syndrome may have been present but the patients were profoundly psychoneurotic and it was difficult to elicit postoperative symptoms accurately.

The night secretion following hemigastrectomy and subtotal vagotomy was 450 cc. 2° acid. This compares with night secretion of 530 cc. 2° following vagotomy and gastroenterostomy in an earlier study.⁹ The preoperative secretions in both groups were essentially the same.

Following hemigastrectomy and subtotal vagotomy the histamine acidity was reduced from a preoperative average of 65.5° to a postoperative average of 25.3°. This is in contrast to the previous study of vagotomy and gastroenterostomy which showed a reduction from a preoperative histamine acidity average of 52.4° to a postoperative average of 45°. Following hemigastrectomy and subtotal vagotomy the insulin acidity was reduced from a preoperative average of 74° to a postoperative average of 18.3°. This was in comparison to our vagotomy and gastroenterostomy study in which the preoperative insulin acidity average was 64° and the postoperative average 13°. It is thus clearly evident that in the present series the addition of antrectomy to vagotomy produced a much greater lowering of histamine acidity than did the addition of gastroenterostomy to vagotomy.

Pronounced loss of weight occurred in two cases. In one case the loss was not regained but the patient was considerably overweight before operation, possibly owing to ingestion of large amounts of cream, and his present weight is normal for his height and build. The patient says he feels well.

None of the patients had anemia postoperatively. There were no complications incident to leakage of the duodenal stump or gastrojejunal anastomosis. None of the patients died.

COMMENT

Surgeons associated with the authors have recently complemented the present study with a series of 42 cases in which the patients were treated by Billroth I hemigastrectomy with attempted complete vagotomy at the Wadsworth Hospital. This phase of the study is being continued. The morbidity so far in this group has been greater than it has been with the Polya-type procedure in our larger series. In four of the 42 cases it has been necessary to replace the gastroduodenostomy with gastrojejunostomy to correct inadequate emptying of the stomach.

While the Billroth I procedure should not be condemned on the basis of results in this small series of cases, certain known objections to it do condemn overenthusiasm for the procedure. In dogs the

duodenum is more resistant to acid than is the jejunum. This is probably true in humans also, although there is no proof of it. However, duodenal regurgitation is spasmodic and neutralization of the potential ulcer area in the anastomosed duodenum is not constant, whereas the jejunal stoma in a Billroth II or Polya procedure is constantly bathed with alkaline duodenal juices. This is consistent with relative achlorhydria in 72 to 75 per cent of cases after Billroth II or Polya operations and in only 40 per cent of cases after Billroth I operations for duodenal ulcer.¹⁵

Theoretically, fat digestion should be aided by food passing through the duodenum. However, in the present series there was no laboratory or clinical evidence of lack of fat digestion associated with the Polya operation.

Although duodenal ulcers may occur in bizarre locations,¹ most of them are within a relatively small area on the anterior wall. In the usual Billroth I procedure, unless the anastomosis is constructed especially to prevent it, after operation the gastric contents, following the magenstrasse, strike the duodenum in relatively the same place as they did before; and it is at that place that most recurrent ulcers form. These factors also obtain with pyloroplasty. Furthermore, the operation is technically not feasible in cases where the duodenum is unduly friable. In a significant number of cases it implies resection of the ulcer, which is unnecessary in the Polya or Billroth II procedure.

Since it is now known that marginal ulcer occasionally occurs even after the most radical subtotal gastric resection with supplemental total vagotomy, it is evident that nothing short of total gastrectomy will completely prevent recurrence. This, of course, is too radical a procedure for a benign lesion.

The crux of the problem rests in the following inescapable facts.

Marginal ulcers following vagotomy and gastroenterostomy have been cured by subsequent hemigastrectomy. On the other hand, marginal ulcers following gastrectomy have been cured by subsequent vagotomy. It seems, therefore, that in the one case the hormonal factor and in the other the vagal factor is predominant.^{9, 10, 11} Unfortunately, no accurate method has been devised to tell which is which preoperatively.

With simplified antrectomy and vagotomy as utilized in the present series, mortality is no greater than with vagotomy and gastroenterostomy. This does not apply to subtotal "adequate" gastrectomy including removal of the ulcer.

From a practical standpoint, then, until preoperative selection of cases can be counted upon, it seems that conservative antral gastrectomy combined with

some form of sectioning of both vagus nerves constitutes a procedure involving minimal anatomic and physiologic mutilation consistent with optimal results.

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